DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

On the whole the month was close to a normal December. Pressure was relatively high in northern districts from the Atlantic to the Pacific and relatively low in the southern third of the country. Temperature was above normal in that section and also in the Pacific Coast States; it was quite generally less than normal from the middle and northern Plateau region eastward to the Atlantic. (See Chart III.) Precipitation was greater than the normal rather generally in the Rocky Mountain States and from Texas northeastward to the Virginias. Droughty conditions prevailed in the Southeastern States, the Lake region, portions of the middle Mississippi Valley, and the Pacific Coast States. (See the inset on Chart IV.)—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. DAY

Twenty-three low-pressure areas were traced in their migrations within the limits of the weather chart during the month of December. This number is rather more than the normal, and these warm-air masses were quite varied with respect to place of origin. The surface pressure gradients, however, were sufficient in only a few cases to cause stormy weather. Only 14 cold-air masses of HIGHS were plotted, and the only important temperature depression occurred during the middle of the month, when a cold-air mass spread slowly southeastward from the Canadian interior and Alaska.

FREE-AIR SUMMARY

By L. T. SAMUELS

An inspection of Table 1 shows negative temperature departures in the lower levels at all stations, with a change to positive in the higher levels at Ellendale, Groesbeck, and Royal Center. Relative humidity departures were small, and those of vapor pressure followed closely those of temperature.

The futility of assuming that the generally accepted average lapse rate of 0.6° C. per 100 m. is even approximately constant irrespective of location or season is clearly brought out in this table. It will be observed that at Ellendale, the northernmost station, the mean temperature at 3,000 m. was practically no lower than the mean at the surface. Although the average lapse rates for this November at the other stations (particularly the eastern ones) were considerably greater than this, yet they were much less than 0.6° C. per 100 m.

From Table 2 it will be seen that the resultant wind movement for the month was close to normal at the aerological stations. This is especially well shown for the country by pilot-balloon observations from 32 well-distributed stations. These show for the 3,000 m. (m. s. l.) level a practically due west direction over the country with the exception of the most northern and Pacific Coast States, where the resultant direction was northwest. It is interesting to note that the highest resultant velocities occurred not at the most northern stations, but over the middle latitudes of the country reaching a maximum at the eastern stations. This is the normal latitudinal relationship both for resultant and average wind velocities when the latter are considered without respect to direction. (See MONTHLY WEATHER REVIEW SUPPLEMENT, No. 26, 1926.)

A kite flight reaching to 4,000 m. made at Due West on the morning of the 27th is of special interest in connection with the occurrence of precipitation over that region considerably earlier than the prevailing sea-level pressure distribution indicated. (See a. m. weather map, December 27). This record was obtained in the southwest quadrant of an extensive anticyclone about midway between its center and periphery. With no precipitation occurring east of Texas at the time and with the entire eastern half of the country under the control of high pressure, it was unusual to find intermittent rains occurring as far east as Due West, where a steady rain set in by midnight and continued throughout the following day. The outstanding feature shown by this record was a cold east-northeasterly surface wind overrun by a very warm one from the south. Accordingly, at 2,100 m., the temperature was 7.2° C., while at the surface it was 1.6° C. and the average lapse rate from 2,100 m. to 4,000 m., 0.45° C. per 100 m.

At the beginning of the flight only high A–St. and Ci clouds moving from the west were present. Before the highest altitude was reached, however, these clouds became obscured by lower St. Cu. moving from south-southeast. Some lower St. moving from the east also appeared. It is of particular interest to find that the already pronounced temperature inversion referred to above became even more marked by the following morning (28th) when a kite flight which was made during rain showed the temperature at 1,250 m. to have increased 10° C. although the surface temperature remained about the same as on the previous day. It is probable that an even higher temperature prevailed above this level, but the altitude of the kites was limited when they became waterlogged and were beaten down by the strong winds (23 m. p. s. from the southwest).

Two explanations of this rain might be advanced—first, the forced ascent of the warm, moist southerly air, and second, the overrunning of the very warm air (as shown by the observation of the 28th) by relatively colder air above.

The chief significance here lies in the fact that pilot-balloon observations were impracticable throughout this whole region on account of the low clouds and precipitation, and therefore kite observations provided the only source of information regarding the upper air. The subsequent increase in this storm's intensity and its very rapid movement northeastward during the following 24 hours are intimately connected with the conditions shown by these kite records. That of the 28th is of particular interest in that it showed a state of saturation throughout this very pronounced inversion layer, a condition not frequently observed.

During another period of low clouds and intermittent rains at Groesbeck on the 20th when ordinarily both kite and pilot-balloon observations would be impracticable a valuable pilot-balloon observation was secured owing to the alertness on the part of the personnel during a temporary break in the lower clouds. With reference thereto the official in charge reports:

> As it was evident that this condition would not last long, the time of the balloon ascension was advanced to 1.21 p. m., thus obtaining an altitude (3,000 m.) that could not have been reached at any other time that day. This observation is of special interest in connection with the rapidly moving LOW attended by heavy rains which crossed the Southern States on the 19th, 20th and 21st.

At the time of this observation Groesbeck appeared to be on the dividing line between a LOW centered over Mexico and a HIGH central over the Atlantic coast. The significant feature shown was a 27 m. p. s. wind from the southwest at and above 1,300 m. elevation, overrunning a light surface wind of 5 m. p. s. This observation is striking, since during the ensuing night this LOW moved rapidly northeastward, being centered over Arkansas the following morning.

On the 11th both the morning and afternoon pilot-balloon observations at Cheyenne indicated exceptionally strong winds at a low elevation. In the morning a maximum velocity of 55 m. p. s. from the northwest was recorded at 800 m. above the surface where the velocity was only 11 m. p. s., while in the afternoon a 53 m. p. s. wind from the west was recorded at 1,000 m. with 16 m. p. s. at the ground. The fact that these were single-theodolite observations introduces an element of uncertainty in accepting these high velocities. The close agreement found between the morning and afternoon observations, however, strongly substantiates their accuracy, as it does not seem probable that a strong downward component would continue for such a long period. A strong area of low pressure central over Saskatchewan provided favorable conditions for chinook winds, and while the sea-level pressure distribution did not indicate such extreme velocities they may have actually occurred over a limited area. Some double-theodolite observations in this mountain region are needed to check up the seemingly erratic velocities occasionally found here.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during December, 1926*

TEMPERATURE (°C.)

Altitude (meters) m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C. (7 meters) (mean)
	Mean	Departure from 9-yr. mean	Mean	Departure from 6-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 9-yr. mean	
Surface	2.6	−1.9	8.1	−0.6	−10.9	−2.1	8.3	−1.0	−2.7	−0.9	0.6
250	2.5	−2.0	8.0	−0.7			8.2	−0.9	−2.9	−1.0	−0.6
500	2.1	−1.9	7.5	−0.9	−10.8	−2.1	8.1	−0.5	−4.7	−1.5	−1.7
750	2.0	−1.9	7.5	−0.7	−9.1	−1.3	8.1	−0.3	−5.6	−1.9	−1.7
1,000	2.1	−2.3	7.3	−0.5	−7.3	−0.6	9.3	+0.7	−5.3	−1.6	−1.7
1,250	3.1	−1.5	6.9	−0.3	−6.7	−0.6	9.3	+1.0	−4.1	−0.5	−1.8
1,500	3.1	−1.2	6.0	−0.3	−6.2	−0.1	9.3	+1.5	−4.3	−0.6	−2.0
2,000	2.0	−0.9	4.6	0.0	−6.9	+0.3	7.4	+1.2	−4.8	+0.2	−2.7
2,500	0.1	−0.7	2.6	−0.1	−8.6	+0.7	5.3	+1.2	−6.8	+0.1	−4.0
3,000	−2.0	−0.4	0.6	−0.1	−10.7	+1.1	3.2	+1.4	−9.1	+0.1	−6.3
3,500	−4.0	0.0	−2.0	−0.4	−13.5	+1.1	0.6	+1.4	−11.1	+0.8	−9.0
4,000	−7.1	−0.3	−5.0	−0.4			−2.4	+1.1			

[1] Naval air station.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during December, 1926*—Continued

RELATIVE HUMIDITY (%)

Altitude (meters) m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C. (7 meters) (mean)
	Mean	Departure from 9-yr. mean	Mean	Departure from 6-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 9-yr. mean	
Surface	73	+2	70	−3	82	0	79	+5	80	0	63
250	73	+2	69	−3			76	+4	80	0	63
500	68	+3	65	−1	81	+1	71	+3	84	+6	62
750	63	+3	62	−1	71	−2	68	+4	83	+9	60
1,000	56	+3	58	−3	64	−2	60	+2	75	+8	59
1,250	43	−3	55	−4	60	−1	56	+2	67	+6	57
1,500	37	−5	50	−7	57	−1	49	−1	66	+8	55
2,000	31	−6	45	−8	52	−3	45	+2	56	+2	55
2,500	31	−5	47	−2	50	−5	42	+3	53	0	56
3,000	31	−5	49	+7	49	−5	41	+5	49	−4	52
3,500	31	−5	48	+6	47	−6	39	+6	44	−10	46
4,000	29	−6	47	+5			58	+24			

VAPOR PRESSURE (*mb.*)

Surface	5.78	−0.67	8.20	−0.66	2.43	−0.39	9.45	−0.20	4.43	−0.18	4.38
250	5.75	−0.65	8.09	−0.67			9.06	−0.24	4.34	−0.21	4.03
500	5.35	−0.36	7.43	−0.63	2.39	−0.38	8.50	−0.02	3.99	−0.01	3.71
750	4.93	−0.23	7.11	−0.42	2.40	−0.22	8.09	+0.30	3.66	+0.07	3.73
1,000	4.34	−0.25	6.40	−0.54	2.41	−0.10	7.68	+0.74	3.32	+0.09	3.76
1,250	3.31	−0.69	5.95	−0.46	2.35	−0.05	7.00	+0.82	3.16	+0.23	3.63
1,500	2.83	−0.76	5.06	−0.74	2.39	+0.12	5.91	+0.53	3.01	+0.31	3.42
2,000	2.09	−0.76	4.01	−0.70	2.10	+0.16	4.84	+0.84	2.45	+0.18	3.10
2,500	1.69	−0.67	3.51	−0.30	1.75	+0.12	4.22	+1.12	1.90	−0.04	2.73
3,000	1.40	−0.60	3.29	+0.32	1.46	+0.16	3.93	+1.46	1.62	−0.06	1.82
3,500	1.29	−0.46	2.81	+0.22	0.99	0.00	3.57	+1.70	1.42	−0.05	0.80
4,000	1.12	−0.39	2.38	+0.32			4.57	+2.87			

TABLE 2.—*Free-air resultant winds (m. p. s.) during December, 1926*

Altitude (meters) m. s. l.	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)	
	Mean		9-year mean		Mean		6-year mean		Mean		9-year mean		Mean		9-year mean		Mean		9-year mean		Mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 75° W.	0.6	S. 56° W.	1.1	S. 72° W.	1.3	S. 69° W.	1.4	N. 81° W.	3.3	N. 54° W.	3.4	N. 17° W.	1.6	N. 67° W.	1.1	S. 69° W.	2.3	S. 56° W.	2.4	N. 29° W.	1.0
250	S. 72° W.	0.6	S. 51° W.	1.3	S. 70° W.	1.5	S. 63° W.	1.6					N. 28° W.	1.0	S. 86° W.	1.3	S. 69° W.	2.5	S. 54° W.	2.6	N. 44° W.	3.0
500	S. 38° W.	1.4	S. 48° W.	3.0	S. 69° W.	4.3	S. 66° W.	3.6	S. 89° W.	4.0	N. 60° W.	3.8	S. 62° W.	1.0	S. 62° W.	2.5	S. 68° W.	5.1	S. 60° W.	5.5	N. 55° W.	6.0
750	S. 54° W.	2.2	S. 53° W.	3.9	S. 70° W.	6.9	S. 70° W.	5.3	S. 89° W.	7.1	N. 59° W.	5.9	S. 74° W.	1.9	S. 60° W.	3.6	S. 75° W.	7.2	S. 69° W.	7.2	N. 58° W.	7.5
1,000	S. 64° W.	2.8	S. 67° W.	4.5	S. 81° W.	8.3	S. 77° W.	6.8	W.			8.3	N. 57° W.	7.0	S. 71° W.	2.9	S. 61° W.	4.8	S. 85° W.	7.9	S. 79° W.	8.4	N. 60° W.	8.1
1,250	S. 76° W.	3.8	S. 78° W.	5.0	S. 80° W.	9.2	S. 78° W.	8.2	N. 83° W.	9.3	N. 58° W.	7.7	S. 80° W.	4.1	S. 67° W.	5.8	W.	8.8	S. 83° W.	10.1		
1,500	S. 78° W.	5.5	S. 81° W.	5.9	S. 82° W.	11.7	S. 84° W.	9.6	N. 78° W.	8.8	N. 57° W.	8.5	S. 85° W.	5.3	S. 70° W.	6.7	N. 85° W.	10.7	S. 89° W.	11.0	N. 73° W.	10.3
2,000	S. 82° W.	7.5	S. 83° W.	7.4	S. 82° W.	16.8	S. 85° W.	11.4	N. 77° W.	11.2	N. 59° W.	10.2	S. 81° W.	7.4	S. 74° W.	8.0	N. 85° W.	12.6	N. 88° W.	12.7	N. 71° W.	11.1
2,500	S. 78° W.	9.0	S. 86° W.	9.4	S. 85° W.	16.2	S. 88° W.	11.8	N. 74° W.	12.7	N. 61° W.	11.9	S. 82° W.	10.3	S. 77° W.	9.6	N. 85° W.	16.1	N. 86° W.	14.5	N. 69° W.	14.9
3,000	S. 77° W.	9.7	S. 89° W.	10.6	N. 83° W.	16.0	N. 86° W.	13.5	N. 72° W.	12.6	N. 64° W.	13.2	N. 76° W.	10.9	S. 78° W.	11.2	N. 89° W.	14.8	N. 89° W.	14.7	N. 72° W.	17.3
3,500	S. 84° W.	12.0	N. 89° W.	12.0	N. 67° W.	16.3	N. 85° W.	14.2	N. 74° W.	15.3	N. 70° W.	14.8	N. 69° W.	13.8	S. 79° W.	11.6	N. 77° W.	17.2	N. 85° W.	13.9	N. 59° W.	18.0
4,000	S. 77° W.	12.7	N. 84° W.	11.9	N. 56° W.	17.7	N. 77° W.	12.9	S. 38° W.	15.2	N. 71° W.	13.5	N. 71° W.	14.6	S. 82° W.	11.5						
4,500	W.		16.0	N. 83° W.	12.5	N. 56° W.	19.2	N. 78° W.	15.7													